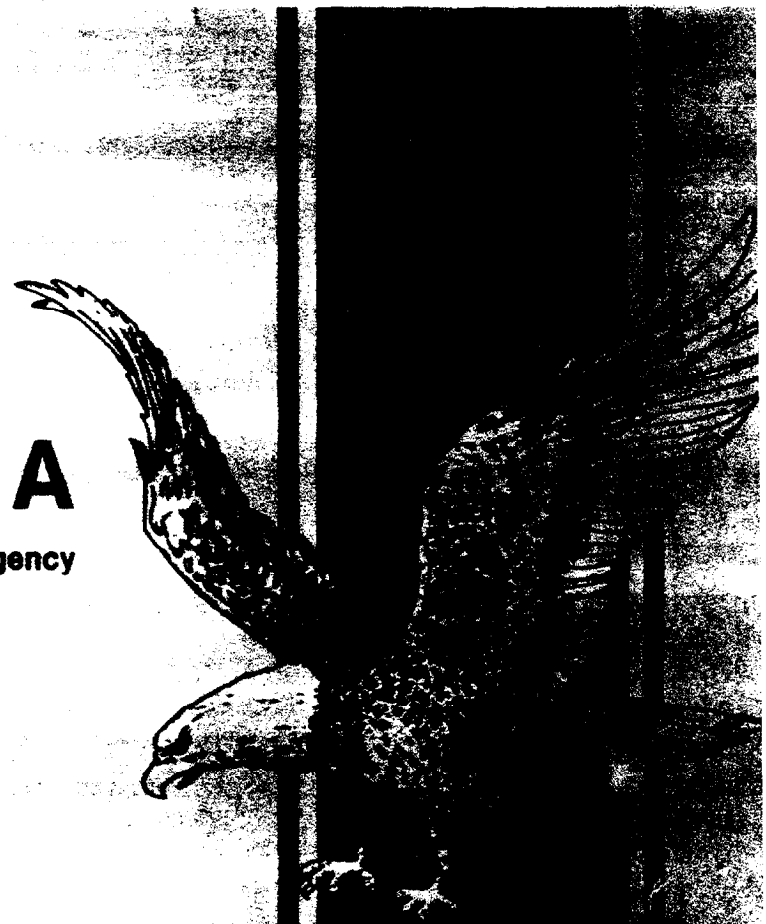

USATHAMA

U.S. Army Toxic and Hazardous Materials Agency

Remedial Action

DECISION DOCUMENT

January, 1988

DDT Contaminated Areas

Redstone Arsenal

US ARMY
MATERIEL
COMMAND

DECISION DOCUMENT
REMEDIAL ACTION

Site: DDT Contaminated Areas, Redstone Arsenal (RSA), Alabama.

Documents Reviewed:

1. Redstone Arsenal (RSA) Installation Restoration Summary, Final Report. Volumes 1, 2 and 3. Water and Air Research, Inc., 1983.

Description of Selected Remedy:

The remedy selected for the DDT contaminated areas of RSA may be summarized as follows:

- Granulated activated charcoal treatment of surface water runoff from contaminated sites.
- Groundwater Monitoring.
- Excavation of DDT contaminated soils, and decontamination of manufacturing facilities.
- Disposal of DDT contaminated soil and debris in a state permitted on-site hazardous waste landfill.

Declaration:

A survey conducted by the U.S. Environmental Hygiene Agency in 1977 revealed extensive surface water and soil contamination downstream of the DDT manufacturing site at Redstone Arsenal (RSA). After subsequent discussions with the Environmental Protection Agency (EPA), the U.S. Army Project Manager for Chemical Demilitarization and Restoration (later named U.S. Army Toxic and Hazardous Materials Agency) and the U.S. Army Missile Command (MICOM) joined in a coordinated effort to abate further migration of DDT from the manufacturing site.

A Calgon water treatment system was installed in January 1979 after examining the feasibility of utilizing carbon adsorption for DDT removal from surface waters discharged from the site. Consistent with the goal of reducing long-term migration, a hazardous waste landfill was constructed on RSA property and all contaminated solids were disposed in it. Groundwater monitoring wells were installed to sample and verify the absence of any DDT contamination of groundwater at the site.

CONCUR: _____ Date: _____

THOMAS D. REESE
Major General, USA
Commanding
Redstone Arsenal

APPROVED: _____ Date: _____

J HAROLD MASHBURN
Colonel, CM
Commanding
U.S. Army Toxic and Hazardous Materials Agency

SUMMARY OF REMEDIAL ACTION
DDT CONTAMINATED AREAS
REDSTONE ARSENAL (RSA)

SITE LOCATION AND DESCRIPTION

Redstone Arsenal (RSA) is located in Madison County in north central Alabama, south of the City of Huntsville (Figure 1). Between 1947 and 1970, a DDT production plant was operated for commercial purposes at RSA by private contractors under lease from the U.S. Army. During its period of operation, the plant discharged wastewater containing DDT residues through an open ditch to a tributary of the Tennessee River (Figure 2). An environmental survey conducted between October 1978 and March 1979 revealed high concentrations of DDT at three former disposal sites and over most of the DDT manufacturing area and DDT ditch (Figures 3 and 4). These manufacturing and disposal areas are located within the drainage basin of Huntsville Spring Branch. This stream is located upstream of the Wheeler Reservoir which drains into the Tennessee River (Figure 3).

On most of the RSA property, the bedrock is overlain by a layer of unconsolidated material. In the areas of DDT contamination, the unconsolidated material is 40 to 80 feet thick. The hydraulic conductivities of clay soils in the unconsolidated material at RSA are extremely low, on the order of 10^{-7} cm/sec. Underlying the unconsolidated material is an artesian limestone bedrock aquifer and the Chattanooga Shale lower confining unit. The ground water on RSA property exists primarily within the limestone bedrock aquifer, the average thickness of which is between 250 and 300 feet. The general direction of ground water flow from the DDT area is towards the Huntsville Spring Branch (HSB) and the Wheeler Reservoir.

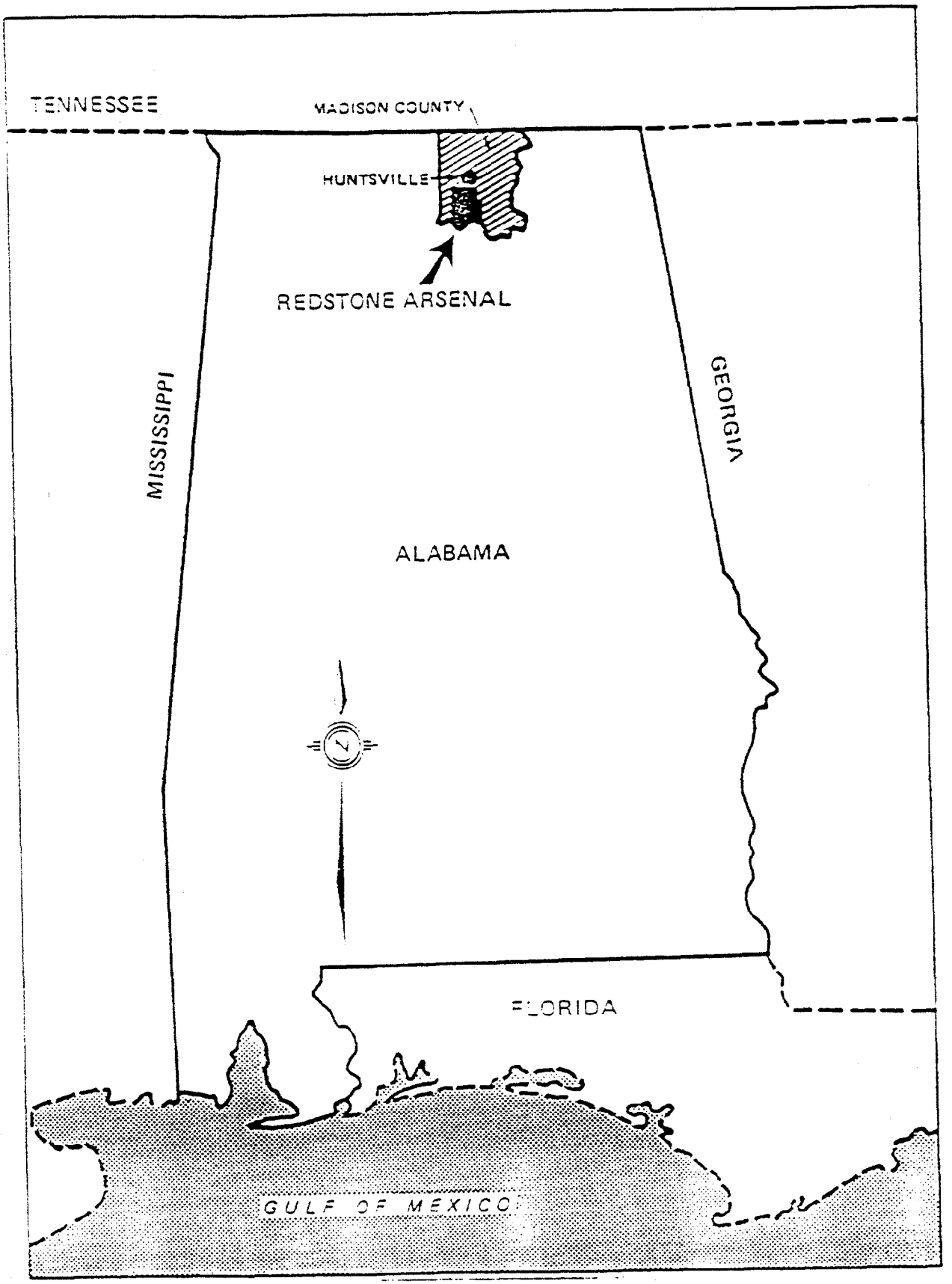

Figure 1. Location of Redstone Arsenal

Source: Water and Air Research, Inc., 1983

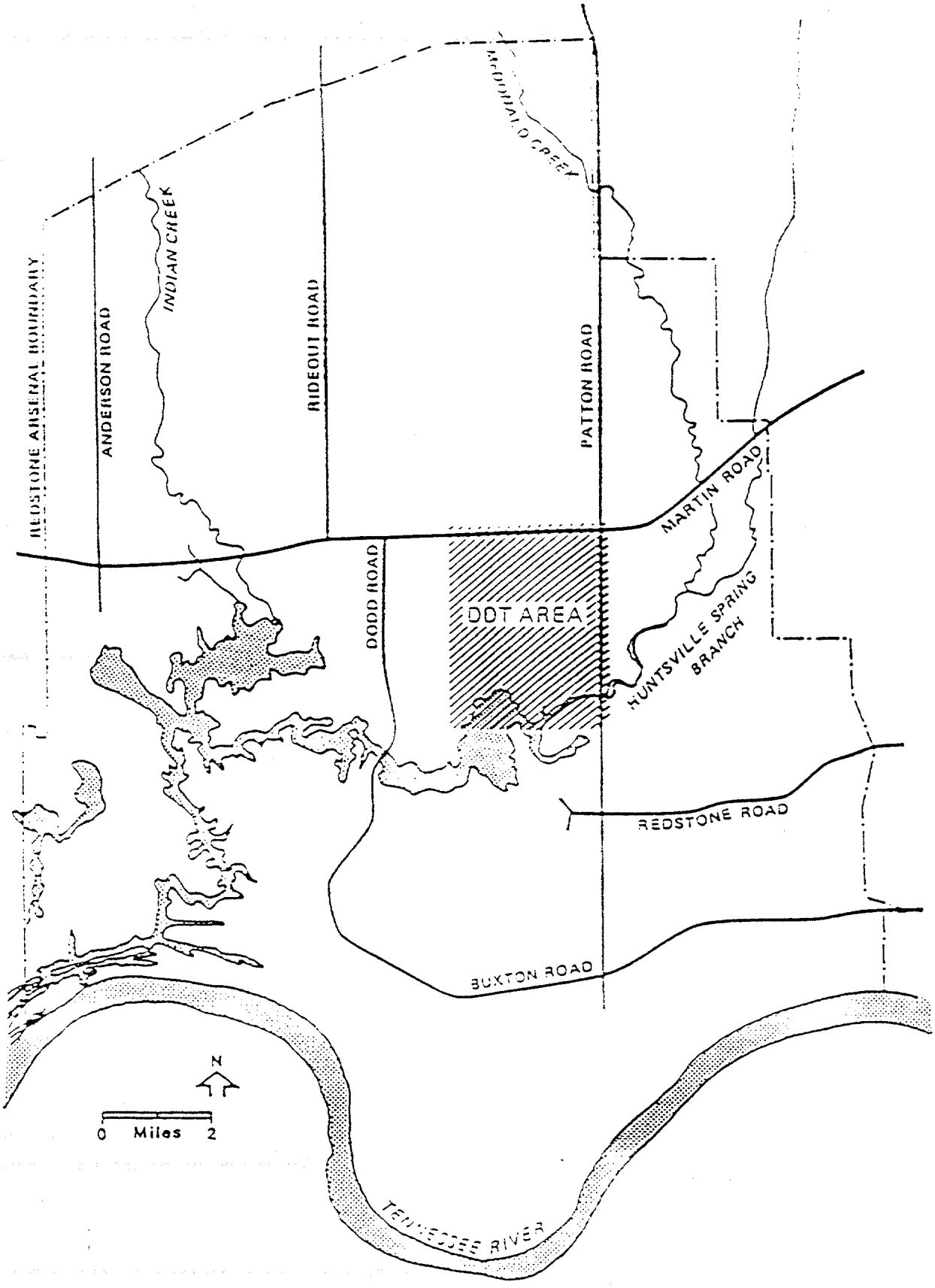

Figure 2. Redstone Arsenal General Site Map
Source: Water and Air Research, Inc., 1983

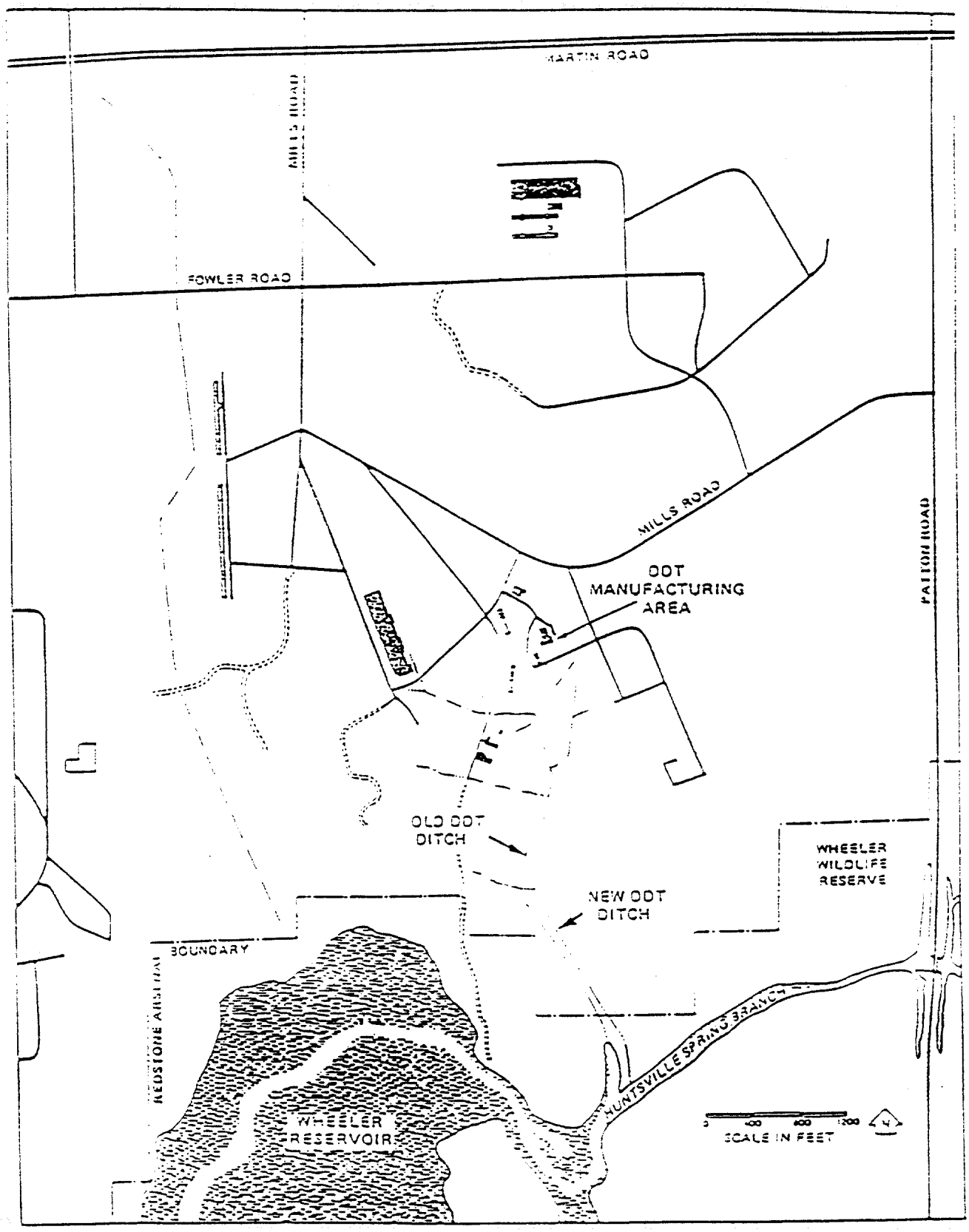

Figure 3. DDT Manufacturing Area and DDT Discharge Ditch

Source: Water and Air Research, Inc., 1983

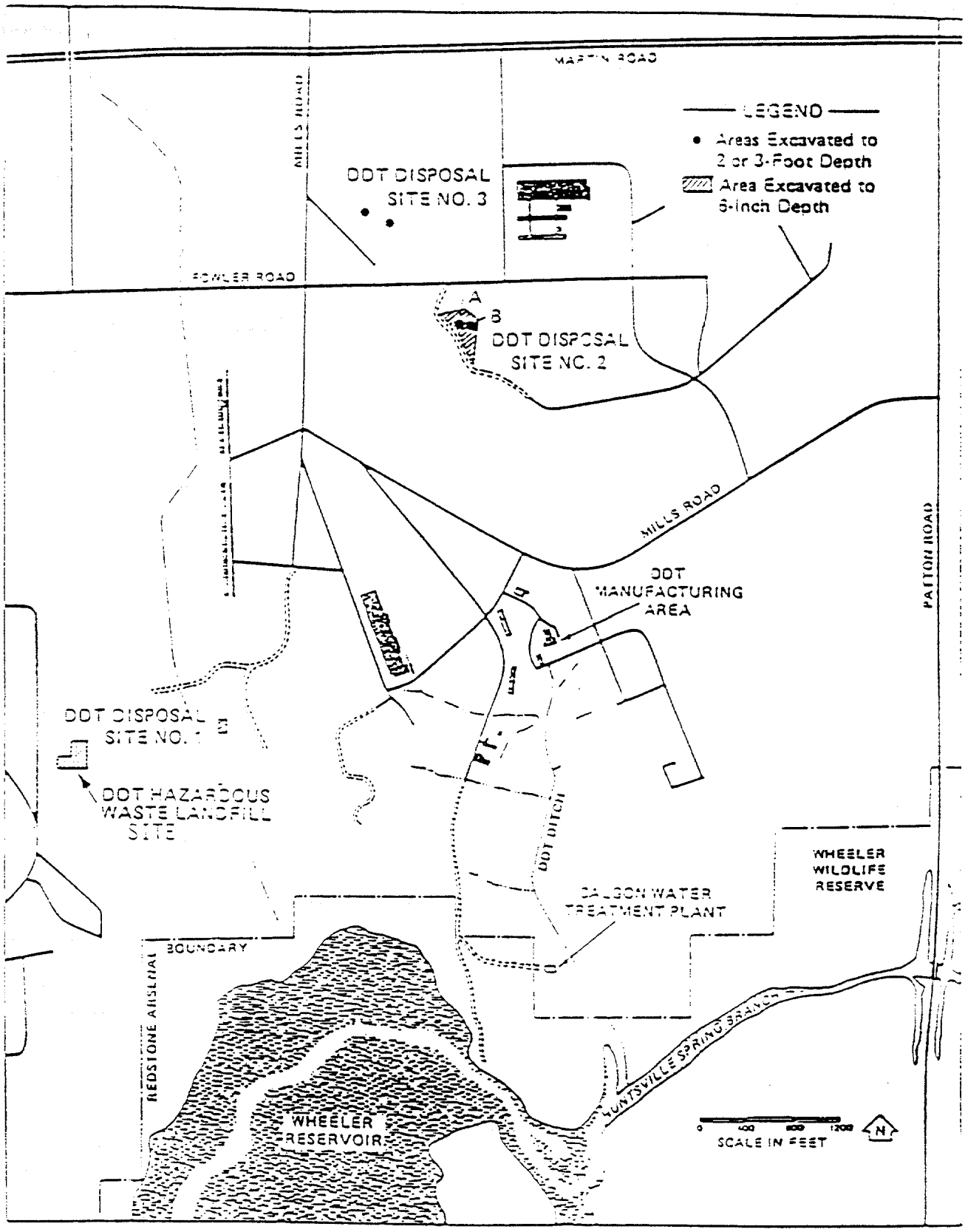

Figure 4. Location Map - Collection and Disposal of DDT-contaminated Materials

Source: Water and Air Research, Inc., 1983

SITE HISTORY

In 1947, the Calabama Chemical Company leased a manufacturing plant (formerly called the Thionyl Chloride Plant) in the 5000 acre area of RSA, approximately 2500 feet north of Huntsville Spring Branch (HSB) to manufacture up to 25 million pounds of DDT per year. As part of the manufacturing process, crystalline DDT was washed with water. The contaminated process and cooling waters were discharged directly into the Huntsville Spring Branch at an estimated rate of 1.5 million gallons per day (MGD). DDT levels in the wastewater measured up to 0.5 mg/L, mainly as particulates (USPHS, 1964). In 1954, the DDT plant lease was taken over by Olin Mathiesen Chemical Company, who in January, 1965, constructed a settling pond to meet a new water concentration standard of 10 parts per billion (ppb). The pond was cleaned periodically, and the residues were buried in nearby landfills. Plant personnel estimated that 12,000 pounds of DDT accumulated by sedimentation in 4 months in the settling pond (USAEHA, 1965), a period during which the production was estimated at 1 to 2 million pounds of DDT per month (USPHS, 1964). Because of problems in meeting the 10 ppb standard as a result of accumulation of DDT in the drainage ditch, a new ditch was dug in June, 1967, parallel to the old ditch. The DDT in the old ditch was neutralized with lime and ferrous sulfate.

Revision of the original 10 ppb standard to 20 ppt (parts per trillion) of DDT in water in October 1969 led to cutbacks in the DDT production. In July, 1970, Olin began adding lime and ferrous sulfate to the pond and the ditch to neutralize DDT the residues. The plant was closed and vacated in November 1971 and demolished in 1972. Sampling of the drainage ditch in April 1977 indicated DDT levels of 66 ppb in water samples and 1385 ppm in the sediment. DDT deposits on the surface of the old manufacturing site measured 98 percent DDT. The results of sediment and biological sample analyses indicated widespread DDT contamination around the ditch, Huntsville Spring Branch, Indian Creek and downstream to the Tennessee River (Figure 2).

SITE STATUS

The mean total DDT concentration in soil samples collected in the DDT manufacturing area measured as high as 7500 mg/kg (8 samples). The mean concentration of total DDT in surface water samples collected at the manufacturing site was 0.073 mg/L. However, the levels of total DDT in the surface water samples indicated the presence of particulate matter because the solubility of DDT in water is below 2 ug/L. These results are summarized in Table 1. Figure 4 shows the sampling points.

The level of DDT in the sediments of the drainage ditch averaged 160 mg/kg (18 samples). Analysis of eleven surface samples collected in the vicinity of disposal site no. 2 showed greater than 99 percent DDT. The results of these analyses, together with visual inspection, were used to define the boundaries of the contaminated areas.

Surface water samples were collected at 14 on-post locations other than drainage ditches associated with the DDT contaminated areas (Figure 5). These sampling points were upstream of the heavily contaminated Huntsville Spring Branch and Indian Creek, and therefore above the DDT manufacturing zone. At each location, the detectable levels of total DDT are indicated. All water samples were at or below the 0.23 ug/L total DDT detection limit.

Samples were also collected from three sludge drying beds and the digester at the RSA Sewage Treatment Plant No. 3. Detectable concentrations of total DDT in sludge samples ranged from 33.4 to 321 mg/kg, high enough to warrant their disposal in landfills (Table 2). However, the source of this contamination has not been determined.

TABLE 1

Summary of DDT Analyses* Associated
with Earthwork and Cleanup

Site	Sample Type	Before Cleanup		
		No. of Analyses	Range+	Mean+
DDT Manufacturing Area	Soil/Sediment	8	14.6 to 18,890	7,500
	Water	2	0.029 to 0.116	0.073
DDT Bagging Area	Soil	0	---	--
DDT Ditch and Tributary Ditches	Sediment	18	0.55 to 744	160
	Water	32	0.00057 to 40.4	3.06
Disposal Site No. 1	Soil	0	---	--
	Water	1	---	0.0013
Disposal Site No. 2	Soil	11	1.421 to 1,018,000	95,700
Disposal Site No. 3	Soil	5	12.4 to 1,230,000	246,000
	Water	1	---	0.00086

* Values indicated represent five isomers:

p,p^1DDE, o,p^1DDD; $p.p^1DDD$; o,p^1DDT and p,p^1DDT

\+ Units reported for water analyses are mg/l. Soil and sediment analyses are reported as mg/kg.

Source: WAR, 1983.

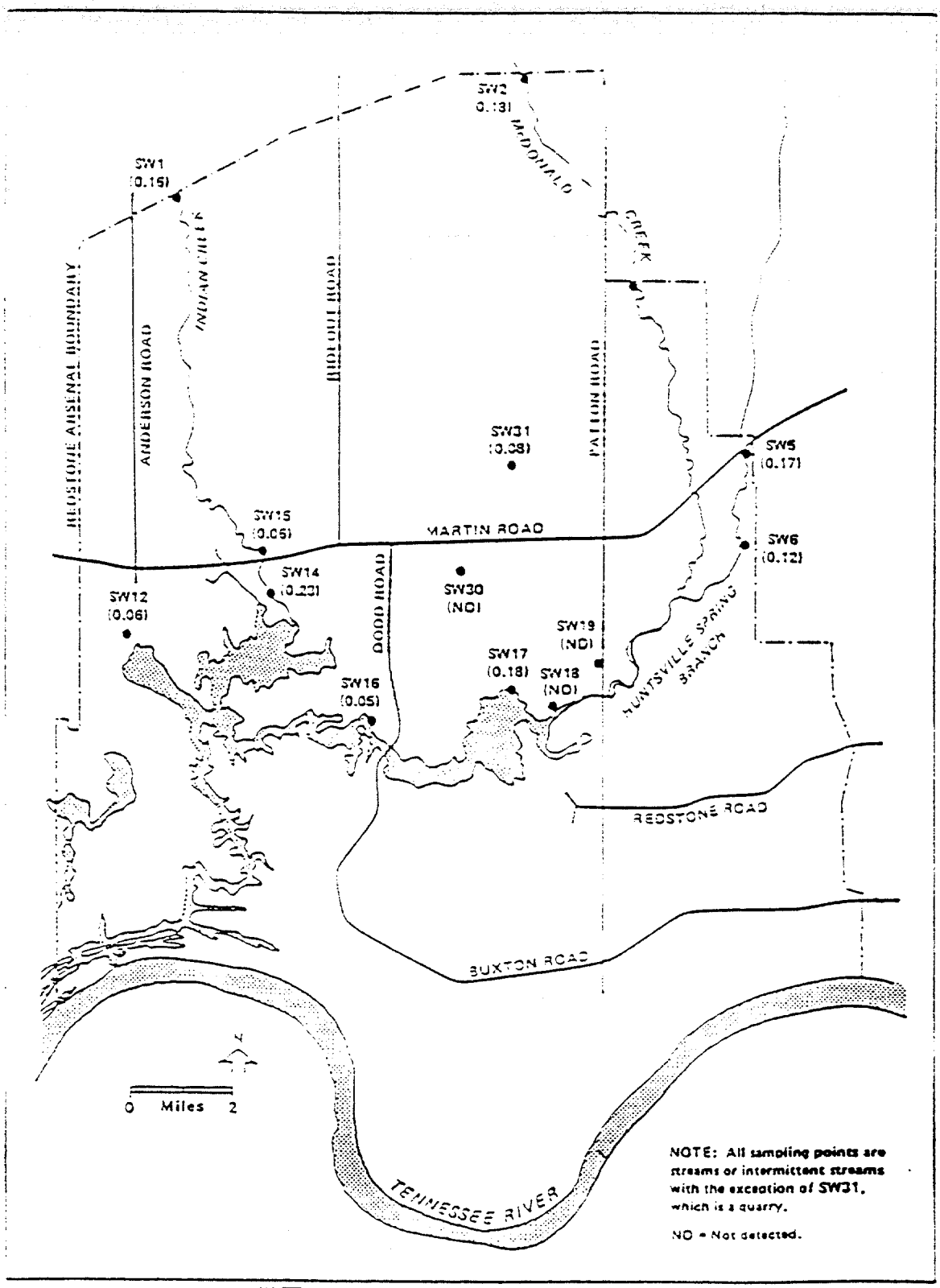

Figure 5. Surface Water Sampling Locations and Results (expressed as ug/l total detectable DDT)

Source: Water and Air Research, Inc., 1983

TABLE 2

DDT Analyses
Sewage Treatment Plant No. 3

Sample Location	Sample Type	Total Detectable DDT mg/kg (sludge) or mg/l (liquid)
Bed No. 1	Sludge	33.4
Bed No. 2	Sludge	321
Bed No. 3	Sludge	43.1
Digester	Liquid	0.0018

Source: Water and Air Research, Inc., 1983

SELECTED REMEDIAL ACTION

INSTITUTIONAL REQUIREMENTS

The EPA Ambient Water Quality Criteria for DDT allows a maximum of 0.24 nanograms per liter (ng/L), corresponding to an incremental cancer risk of 10^{-5} (one per 100,000) over a lifetime. However, as has been mentioned earlier, this was three orders of magnitude below the detection limit of 0.23 ug/L of instruments calibrated for DDT analyses.

The effluent limitation from dam No. 4 downstream of the Calgon water treatment plant, was regulated by an NPDES discharge permit (Figure 6). This permit set an effluent limitation of 0.6 ug/l for total DDT. This was the desired detection limit for the RSA sampling program.

Onsite treatment and disposal operations were required to be in accordance with the substantive technical requirements of the RCRA. The State of Alabama issued the permits for onsite landfill construction.

SELECTED REMEDIAL ACTION

The remedial action deemed necessary to prevent further DDT migration consisted of:

- Utilizing carbon adsorption for removal of DDT from the DDT discharge ditch.

- Collection and disposal of DDT contaminated soils, sediments and debris in an onsite landfill.

Short Term Measures

A short term migration abatement program was necessary as an interim response measure to control DDT migration from the DDT manufacturing area. Tasks in this work included:

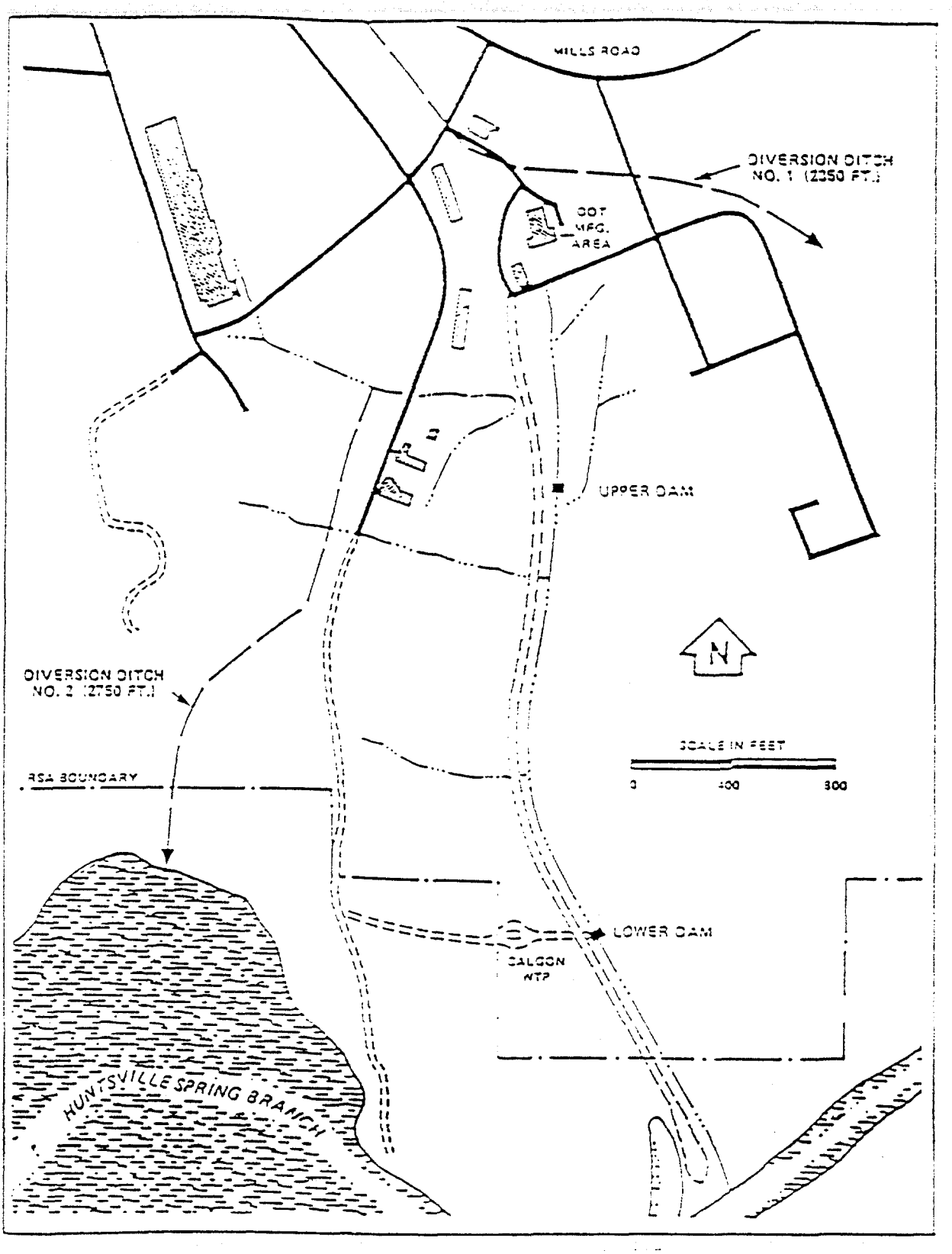

Figure 6. Surface Flow Diversion Associated with Short-Term Migration Abatement

Source: Water and Air Research, Inc., 1983

Task		Schedule
1.	Cleaning the area and initiating topographic survey	12/1/77
2.	Filling and sealing the old DDT settling basin	10/28/77
3.	Diverting surface drainage from the DDT manufacturing area	11/4/77
4.	Installing low level sediment barriers	11/19/77
5.	Constructing two retention dams in the DDT discharge ditch	12/1/77
6.	Continuing engineering evaluation of carbon adsorption and other DDT removal systems	12/1/77

Diversion ditches and retention dams associated with this work are shown in Figure 6.

Long Term Measures

A. Water Treatment System Operation and Surveillance

A granular activated carbon water treatment plant was installed to limit off-site discharges of DDT-contaminated water that were anticipated in connection with long-term cleanup measures (i.e., dredging) in the DDT ditch. The treatment system was operated on lease from Calgon Corporation to RSA.

System Maintenance: The contractor (Calgon Corporation) was responsible for maintenance of all electrical and mechanical equipment. Routine maintenance was the responsibility of a subcontractor to Calgon. RSA personnel were responsible for limited operation/maintenance functions such as daily inspections, instrument monitoring and cleaning out the filter backwash tank.

B. Collection and Disposal of DDT-Contaminated Material

This involved:

1. Construction of a hazardous waste landfill at RSA to dispose of DDT contaminated materials. The landfill was constructed under a permit issued by the State of Alabama to provide a secure disposal site for DDT contaminated materials removed from the manufacturing site and associated dumps and drainage ditches. The soil parameters were examined to verify the suitability of the site. The sides and bottoms of the pits of the landfill consisted of a minimum of two feet of natural or implaced low-permeability compacted clay. Soils and other DDT contaminated materials were placed in the pits (of the landfill) in one foot layers and compacted by a minimum of six passes with a vibrating roller. Rain water which had collected in the pits was pumped to the Calgon WTP for treatment. After each pit was filled, it was sealed with two feet of compacted clay. Groundwater monitoring wells were installed at the time of the landfill construction. Periodic maintenance and monitoring has been carried out since the construction.

2. Restoration of the DDT manufacturing site, including partial demolition of the manufacturing building, plugging of pipes and sewers, and excavation of DDT contaminated materials.

3. Excavation and disposal of contaminated material from the DDT ditch.

4. Cleanup of former DDT waste disposal areas. The soils and debris were excavated and placed in the hazardous waste landfill.

An itemized list of work performed under this task is presented in Table 3.

Post Remedial Actions

A close analyses of monitoring wells and lysimeter data indicated that elevated levels of DDT in groundwater samples collected during phase II of the contamination survey were probably a result of well or sample contamination. A detailed discussion is presented in the RSA Installation Restoration Summary, Water and Air Research, Inc. (1983). Therefore, it was concluded that the levels of groundwater contamination, if any, did not necessitate treatment.

The extensive cleanup efforts undertaken in the DDT manufacturing and ditch discharge areas have greatly reduced surface DDT contamination. Migration of residual contaminants was reduced to low levels by an extensive system of diversion ditches, berms, and sediment retention dams. DDT loadings in the DDT ditch discharge (including plant flow and dam overflow) were estimated from Calgon WTP data for the 3.4 years of plant operation. DDT loadings decreased from 7.2 pounds in 1979 (11 months) to an average of 1.0 pound per year from January 1980 to June 1982.

Additional work completed in September 1982 included the construction of two sediment retention dams in the DDT ditch and the diversion of surface drainage from areas draining into the DDT ditch, reducing its drainage area by about 67 percent. As of June 30, 1987, no additional follow-up work has been recommended.

TABLE 3

Itemization of Earthwork and Clean-Up By Task:

Collection and Disposal of DDT-Contaminated Material

Task	Item	Unit	Quantity
Construction of Hazardous Waste Landfill	Clearing and grubbing	Acre	2.1
	Excavation of contaminated material	Cu. Yd.	22,200
	Back fill	Cu. Yd.	5,500
	Grading for haul road	Job	1
	Gravel for haul road	Cu. Yd.	720
	15 in. reinforced concrete pipe	L.F.*	25
	Barbed wire fence	L.F.*	1,550
	12 in. reinforced concrete pipe	L.F.	75
Restoration of DDT Manufacturing Site and Former Disposal Sites	Demolition and sealing pipes	Job	1
	Remove fire hydrant and post indicator valves	Job	1
	Excavation of contaminated material	Cu. Yd.	3,[illegible]
	Hauling contaminated material	Cu. Yd.	13,450
	Compacting contaminated material	Cu. Yd.	10,300
	Fertilize and seed areas	Sq. Yd.	23,000
Restoration of DDT Ditch	Excavation of contaminated material	Cu. Yd.	3,300
	Hauling contaminated material	Cu. Yd.	3,300
	Placement in landfill	Cu. Yd.	3,300
	Borrow and placement	Cu. Yd.	30
	Mobilization and clean-up	L.S.	

* L.F. = Linear feet.

Source: Water and Air Research, Inc., 1983.

REFERENCES

1. U.S. Army Environmental Health Agency. "DDT Pollution at Redstone Arsenal". (1965).

2. USATHAMA, "Installation and Restoration Program". (June 1987).

3. U.S. Environmental Protection Agency (EPA). "Ambient Water Quality Criteria for DDT". EPA 440/5-80-038. (1980).

4. U.S. Public Health Service (USPHS). "Stream Pollution and Industrial Wastes Survey at Redstone Arsenal". (1964).

5. Water and Air Research, Inc. "Redstone Arsenal (RSA) Installation Restoration Summary". Final Report. Vol. I, II and III. (March 1983).